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VIA ELECTRONIC DELIVERY

May 26, 2017

Mrs. Leslie Blake
Remedial Project Manager
U.S. EPA, Superfund Division
Mail Code SR-6J
77 W. Jackson Blvd.
Chicago, IL 60604

**Re: Gary Development Landfill Superfund Site
Risk Assessment Approach Memorandum**

Dear Mrs. Blake:

On behalf of the Gary Development Landfill Site Group (Respondents), attached for your review and approval is a Risk Assessment Approach Memorandum which was prepared by the Respondents' Remedial Investigation contractor. Submittal of this document is in accordance with Section 3.8 of the Remedial Investigation/Feasibility Study Work Plan.

If you have any questions regarding this submittal, please contact me at (865) 691-5052.

Sincerely,
de maximis, inc.

Michael H. Samples
Alternate Project Coordinator

MHS/
Attachment

cc: (w/ attachments, via email)
Stephanie Andrews (IDEM)
David Rieser, Esq. (K&L Gates)
B. Underwood (*de maximis, inc.)*
Mark Raybuck (Parsons)
GDL Site Technical Committee

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40 La Riviere Drive, Suite 350 • Buffalo, New York 14202 • (716) 541-0730 • Fax (716) 541-0760 • www.parsons.com

To: Gary Development Landfill PRP Group   Date: May 24, 2017

From: Mark Raybuck (Parsons)   Email: mark.raybuck@parsons.com

Subject: Risk Assessment Approach Memorandum
Gary Development Landfill Superfund Site, Gary, Indiana

Introduction

A general approach to conducting the human health and ecological risk assessments was outlined in Section 3.8 of the remedial investigation (RI) / feasibility study (FS) Work Plan (RI/FS Work Plan) (Parsons, 2016) with a statement that a more detailed approach would be provided to the EPA prior to conducting the risk assessments. This memorandum provides that additional detailed approach for the risk assessment, including the primary guidance, assumptions and methods to be employed. It also provides updates to the initial Conceptual Site Model (CSM) provided in the work plan as part of the exposure assessment process (Figures 2-1 through 2-4), based on the observations and information obtained to date from the RI. Additionally, the data collected in support of the RI/FS will be used to quantify potential risk. The sample data to be used in the risk assessments include soil gas samples, surface water and sediment samples from the Northern Pond, sediment samples from the southern wetlands, groundwater data from the perimeter monitoring wells, and surface and subsurface soil samples collected from across the Site.

On August 21, 2015, the EPA approved a presumptive remedy of containment for the former landfill, that provides a mechanism to streamline the risk assessment. The approach herein incorporates the assumption that the presumptive remedy will be applied.

Preliminary Data Summary

The data collected in 2016 have been reviewed, tabulated, and summarized, and provided to EPA in submittals dated December 2016 and February 2017. Data Quality Objectives (DQOs) were based on EPA Region V Data Validation guidelines for Superfund sites using the National Functional Guidelines for Superfund Organic/Inorganic Methods Data Review, October 2013. The data were collected in accordance with the procedures and methods outlined in the Quality Assurance Project Plan (QAPP) in the RI/FS Work Plan (Parsons, 2016). These data will be used to identify constituents of potential concern (COPCs). Locations of all samples, including background surface water and sediment samples collected from a pond to the northeast of the Site, are shown in Attachment 1. As part of the risk assessment process, the analytical results will be compared to regulatory and risk-based screening levels for each media as part of the dose-response assessment process, to identify COPCs based on their toxicological properties.

Groundwater

Groundwater was analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, mercury, and cyanide. No light, non-aqueous phase liquids (LNAPL), dense, non-aqueous phase liquids (DNAPL), PCBs or pesticides were detected in groundwater in 2016. In January 2017, liquid waste was visually observed in two test pits in the southern half of the Site. Confirmation and extent of this waste will be evaluated with a supplemental test pit investigation, as presented to EPA in a memorandum dated March 24, 2017.

Overall, benzene, toluene, ethylbenzene and xylenes (BTEX) represented the highest concentrations of the analyzed VOCs in groundwater. BTEX was found in a limited area in the northeast corner of the Site, with a few isolated detections of benzene across the Site. Chlorinated VOCs, including 1,1-dichloroethane, 1,2-dichloropropane, tetrachloroethene, trichloroethene and vinyl chloride were also detected in limited areas, with the highest detections in Geoprobe sample GP13B.

In the permanent monitoring wells, low concentrations of chlorinated VOCs were found in MW03S, MW06S, MW06D, MW06M, MW07M, and MW08D. These included 1,2-dichloroethene, vinyl chloride, chlorobenzene, and chloroethane.

Polycyclic aromatic hydrocarbons (PAHs) and various phenols were the most commonly detected SVOCs in groundwater, with the highest concentrations located in the eastern half of the site. Metals, particularly, arsenic, barium, cobalt, lead and selenium had scattered elevated detections above tap water screening levels.

Soil Gas

Soil gas samples were also collected in 2016 and analyzed for VOCs (method TO-15) and methane. BTEX were the most commonly detected VOCs (from the TO-15 list) and had the highest detected concentrations of the analyzed VOCs in soil gas samples. Methane was also detected in several of the soil gas samples. However, soil gas probes were all installed within the limits of the landfill, due to the extent of waste material, and other constraints such as access and shallow depths to water. Thus, they represent higher concentrations of both VOCs and methane than would be expected outside of the landfill limits. Also, exposure to methane is not typically addressed in a human health risk assessment as it is relatively non-toxic when inhaled (NLM, 2014).

Surface Water

Surface water samples collected from the Northern Pond were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. No seeps or other surface water bodies were identified at the Site. Metals were the most commonly detected compounds in the surface water samples, but at low concentrations near the detection limits. There were no detections of VOCs, pesticides or PCBs and only two detections of SVOCs in the surface water samples.

Sediment

Sediment samples were also collected from the Northern Pond and the southern wetlands and analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury and cyanide. Metals, PAHs, and PCBs were the most commonly detected constituents. The only pesticides detected in the sediments were Dieldrin and DDD. The highest detections of PCBs and metals, particularly arsenic, lead and zinc, were in the southern wetlands.

Soil

Likewise, surficial and subsurface soil samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury and cyanide. Metals and PAHs were the most commonly detected constituents in surface soils with metals, PAHs, BTEX and PCBs being the most frequently detected in the subsurface soil samples. Dieldrin, Endrin, DDD and DDE were the only pesticides detected in soils with Dieldrin being the only pesticide detected in subsurface samples.

Conceptual Site Model Review

The conceptual site model presented in the RI work plan (Figures 2-1 through 2-4) has been updated to reflect current conditions (Attachment 2). During the RI, waste material was discovered to have extended further out from the landfill, approaching the east and west property boundaries, and extending further south than anticipated. A summary of updates to the conceptual model are provided below.

Human Health

Groundwater

Because institutional controls can be implemented to exclude residential use and installation of drinking water wells, there will be limited complete exposure pathways for groundwater. Regarding the potential for offsite groundwater exposure, a water well inventory was conducted, and submitted to EPA in April 2016. No public water supply systems using wells, nor private potable water supply wells, were identified within a one-mile radius of the Site. Additionally, a City of Gary July 2006 ordinance (Ordinance No. 7930) prohibits new potable water supply wells and requires connection to the City's piped water supply, if available. Since all the properties within a 2,000-foot radius of the site are zoned for industrial use by the Cities of Gary and East Chicago, it is unlikely that the surrounding properties would be developed for residential use. Thus, the only remaining pathways would be for utility or maintenance workers conducting excavations or digging, with potential exposure to impacted groundwater or vapors partitioning from shallow groundwater.

Soils

Likewise, since a cap will be installed to prevent exposure to underlying soils, there will be no direct exposure to soils for future maintenance/landscape/utility workers or trespassers under the presumptive remedy, assuming a trench does not penetrate below the cap. Engineering controls and/or site work permits can also be used to control future maintenance/utility worker exposure to underlying soils. The areal extent of the cap will need to be considered during the feasibility study. Currently, however, it is assumed that the waste material can be capped.

Air/Vapor

As mentioned above, there is a potential for maintenance/utility workers to contact vapors partitioning from groundwater into a trench; however, engineering controls and/or site work permits could be used to control future maintenance/utility worker exposure to groundwater in a trench. In addition, administrative controls to prevent building on the cap can be implemented, thus limiting or removing onsite indoor air inhalation exposure pathways. Details and extent of the capping system, which may also limit the potential for vapor intrusion, will be developed during the feasibility study. Very shallow depths to groundwater at the perimeter of the landfill will further limit vapor intrusion, as there is essentially no vadose zone for vapor intrusion.

Surface Water and Sediment

Site maintenance workers and trespassers could be potentially exposed to constituents detected in the Northern Pond via direct contact and incidental ingestion. Recreational users of the river (not part of the Site) could be exposed to surface water and sediments in the river, as well as exposure via fish consumption. There is, however, an active “do not eat” fish consumption advisory for the river for all fish, issued by the Indiana Department of Health, so exposure via fish consumption is insignificant.

Ecological

For the ecological conceptual site model, terrestrial and aquatic receptors have potential exposure to the surface water and sediments of the pond via uptake and direct contact and via the food chain.

Under the presumptive remedy, a cap minimizes the potential for contact with constituents detected in the underlying soils.

Ecological Risk Assessment Approach

The Screening Level Ecological Risk Assessment (SLERA) document preparation will follow USEPA guidelines presented in the Ecological Risk Assessment Guidance for Superfund (ERAGS): Process for Designing and Conducting Ecological Risk Assessments (USEPA 1997). Per ERAGS guiudance, the ecological risk assessment may be streamlined or end after the screening level step, if the data collected during the RI show minimal risks or lack of completed pathways.

One of the first steps for the SLERA was to identify potential threatened and endangered (T&E) species and sensitive habitats that may occur at and adjacent to the site. A literature search and site-specific field surveys that were done in May 2016 to identify ecological habitats and the potential for T&E species. Based on this review and site inspection, no observations of any T&E species were made. Marginally-suitable habitat was identified for one state-listed endangered species, Blanding's Turtle, which consists of the 2.22-acre marsh area in the southern portion of the Site that borders the Grand Calumet River. Most of the Site is dominated by the invasive *Phragmites australis*, and therefore, provides only low quality habitat for area species.

Since no T&E species were identified and only a small portion of the Site has marginally-suitable habitat dominated by an invasive species, the plan to remediate and cap the Gary Development Landfill is not likely to adversely affect any listed species.

The purpose of the SLERA is to determine the potential risk to onsite biological communities exposed to constituents of potential ecological concern (COPECs) in surface soil, surface water, sediment, and groundwater. The risk assessment is a procedure used to estimate both current and future potential adverse effects on the environment from chemical exposure. The SLERA serves as the basis for evaluating risk posed by COPECs if current conditions are maintained, or if remedial activities and institutional controls are implemented.

The updated conceptual site model described above identifies the receptors, media and exposure pathways that are anticipated to be evaluated. For ecological receptors, the risk evaluation approach for direct exposure pathways will be based on organism communities, while representative ecological receptor species will be used to assess the food/prey ingestion exposure pathway. COPECs will first be identified by screening the collected data against naturally occurring background levels (such as the surface water and sediment samples collected from the background pond to the northeast of the Site, or applicable background concentrations developed by the Illinois Environmental Protection Agency (IEPA) for metropolitan areas (IEPA, 2007). Essential elements and constituents detected below background will be eliminated from further consideration in the SLERA.

For direct soil exposure pathways, risk to plant and soil invertebrates will be evaluated for communities of organisms, not by evaluation of individual species. In this risk evaluation approach, COPEC levels in soil represent the exposure concentration for potentially affected organisms. This exposure concentration is then compared to reference concentrations indicative of potential adverse effects. Sources for these reference values are discussed below.

Similarly, exposure of aquatic organisms and potential adverse effects are evaluated for aquatic communities considered as an assemblage composed of multiple species. In the aquatic pathways, COPEC concentrations in surface water and sediments are the measures of exposure. In the risk evaluation, COPECs are compared to water quality standards and sediment no observable adverse effect levels (NOAELs) and low observable adverse effect levels (LOAELs) for aquatic life protection. Because water quality standards and sediment screening levels are derived from data on multiple fish and invertebrate species, they provide a wide representation of various types of potentially impacted aquatic organisms.

Reference water quality standards by the State of Indiana (IDEM 2014), supplemented with the USEPA Region 4 freshwater screening values (2015), will be used for surface water screening. Ecological screening values (ESVs) and refinement screening values (RSVs) compiled by USEPA (2015) will be used to assess sediment quality.

Representative ecological receptor species will be used to assess ecological risk through the food/prey ingestion exposure pathway. Commonly occurring wildlife species from various trophic levels were selected as representative ecological receptors to evaluate risk of soil COPECs. Use of ecological receptors is a screening method to identify the potential for adverse effects on biological communities. When potential adverse effects are identified for a specific ecological receptor, a potential risk can also be assumed for other wildlife species having similar diet composition and mobility.

The representative bird and mammal species that will be evaluated as wildlife ecological receptors are species whose presence or potential habitat is found onsite or in the vicinity. Selected receptors include five bird and four mammal species that are representative of the herbivore, insectivore, omnivore, and carnivore trophic levels, are relatively more sensitive to impacts, and have smaller home ranges: groundhog, short-tailed shrew, deer mouse, red fox, Canada goose, song sparrow, American robin, red-tailed hawk and osprey.

To quantify ecological receptor dietary exposure, ingestion will be expressed as a daily dose based on COPEC concentration in food/prey. COPEC concentration in food and prey organisms, in turn, will be calculated from soil concentrations using soil-to-biota transfer factors. Wildlife exposure to COPECs will account for incidental ingestion of soil or sediment, which may be a significant COPEC source for herbivore species feeding on underground portions of plants, and for insectivore species feeding on soil dwelling invertebrates.

Species-specific data on food ingestion rates will be obtained from USEPA's Wildlife Exposure Factors Handbook (USEPA, 1997), and ingestion rates derived for surrogate wildlife species (USEPA 2003). For the risk evaluation, representative body weight values and ingestion rates will be used for any given ecological receptor (e.g. median value of reported ranges). Dietary exposures to be used in risk evaluation will be calculated based on both soil average concentration and 95% UCL concentrations. Table 3-1 (Attachment 3) presents a summary of the proposed exposure parameters for the selected ecological receptor species.

Toxicity reference values (TRVs) will be used in the characterization of ecological effects. TRVs are species-specific and chemical-specific estimates of an exposure level that may cause unacceptable adverse effects on growth, reproduction, or survival. Two types of TRVs will be used in the risk evaluation:

- A dose-based TRV (expressed in units of mg/kg-day), to be used in the evaluation of risks to wildlife via ingestion pathways; and
- A concentration-based TRV (expressed in units of mg/unit of medium, e.g. mg/L of water, mg/kg of soil) to be used in evaluating risk to ecological

receptors in direct contact with a contaminated medium (e.g. plants, soil invertebrates, aquatic biota).

The assessment of ecological risk will be based on the development of ecological hazard quotients (HQs). HQs are threshold values indicative of a level of exposure below which it is unlikely for even sensitive populations to experience adverse effects. For a direct exposure pathway to a given COPEC, HQs will be calculated as the ratio of the COPEC exposure concentration in the medium and the applicable TRV. For dietary intake, HQs for food/prey ingestion will be calculated by comparison of TRVs and estimated intakes.

Human Health Risk Assessment Approach

As with the SLERA, the updated conceptual site model will identify the receptors, media and exposure pathways that are anticipated to be evaluated. Constituents of potential concern (COPCs) will be identified by screening the collected data against risk-based screening concentrations (RBSCs). Essential elements and compounds detected equal to or below naturally occurring background levels will be eliminated from further consideration. The human health risk assessment may be streamlined, as the presumptive remedy will address migration pathways and eliminate or minimize direct contact exposure.

The primary guidance documents and references to be used for the HHRA will include:

- Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A) (USEPA, 1989)
- Exposure Factors Handbook, (USEPA, 2011)
- RAGS, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA, 2004)
- RAGS, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA, 2009)

Screening levels for human health will incorporate current USEPA and IDEM guidance. The risk management criteria that will form the basis for the screening levels will be the USEPA and IDEM cancer risk level of 1×10^{-5} and a non-carcinogenic hazard index of 1 or less, since the Site and immediate surroundings are commercial/industrial properties and a presumptive remedy approach will be used. For background soil, because of the proximity to Chicago, Illinois, applicable background concentrations developed by the Illinois Environmental Protection Agency (IEPA) for metropolitan areas will be used (IEPA, 2007).

The HHRA will evaluate the reasonable maximum exposure (RME) risk estimate, as defined by USEPA (1993). The RME is designed to be a measure of “high-end” exposure. The most sensitive exposure parameters are identified and the maximum of several of these are used along with average values for the remaining parameters. Additionally, 95% UCLs on the mean concentrations will be used to estimate exposure to contaminants in each of the environmental media for which sufficient samples have been collected to reliably calculate a 95% UCL. This approach is intended to account for both uncertainty in the contaminant concentration and variability in the exposure parameters (such as exposure frequency or averaging time). Consistent with RAGS (USEPA, 1989), current and future land-use scenarios will be considered for the Site as shown on Figures 2-3 and 2-4 in Attachment 2.

Exposure point concentrations (EPC) are the concentrations of chemicals in each medium to which a receptor may be exposed at a specific location known as the "exposure point." EPCs will be estimated using a combination of available analytical data and fate and transport modeling data to represent the RME that is expected to occur at the Site. EPCs for soil will be calculated as the 95% UCL on the mean or the maximum detected concentration, whichever is lower (USEPA, 1989). The 95% UCL will be calculated using parametric methods (for a normal or lognormal distribution) or nonparametric methods if data are not normally or lognormally distributed (USEPA, 1992). All 95% UCLs will be calculated using the latest version of USEPA's ProUCL software. Because of the possibility of exposure to individual locations, 95% UCLs will not be calculated for air samples. Groundwater EPCs will be based on the maximum concentration since there are not enough samples to calculate a 95% UCL in individual wells.

RME exposure estimates will be used in the HHRA. The RME is designed to be a measure of "high-end" exposure and is the maximum exposure reasonably expected to occur in a population. The most sensitive exposure parameters will be identified, and the 90th percentile of several of these parameters will be used, along with average values for the remaining parameters. This approach is intended to account for both uncertainty in the contaminant concentration and variability in the exposure parameters (such as exposure frequency or averaging time). A summary of the proposed exposure parameters to be used in the HHRA are provided in Tables 3-2 and 3-3 in Attachment 3 for the site trespasser and recreational user, respectively. For evaluating a maintenance/landscape/utility worker's exposure to VOCs in groundwater volatilizing to trench air, the Virginia Department of Environmental Quality (VDEQ) trench model and associated default exposure parameters will be used (VDEQ, 2016). The VDEQ trench model uses a combination of a vadose zone model to estimate volatilization of gases from contaminated groundwater into a trench and a box model to estimate dispersion of the contaminants from the air inside the trench into the above-ground atmosphere.

Human intake, expressed as milligrams of chemical per kilogram of body weight per day (mg/kg-day), will be obtained by multiplying the EPC by the exposure factors specific to an exposure scenario. The resultant intake will be combined with a carcinogenic slope factor, or compared to a non-carcinogenic reference dose, to derive the carcinogenic and non-carcinogenic risks associated with potential exposures from the Site.

The most recently available toxicity data will be used to calculate carcinogenic and non-carcinogenic risk. This will include the most recent Integrated Risk Information System (IRIS) updates. Provisional Peer Reviewed Toxicity Values (PPRTV) will be used to supplement toxicity factors, if necessary.

To characterize potential non-carcinogenic effects, comparisons will be made between projected intakes of substances and reference doses or reference concentrations. To characterize potential carcinogenic effects, the incremental probability of an individual developing cancer over a lifetime will be calculated from projected intakes and chemical specific carcinogenic potency factors.

For each COPC having available toxicity values, a cancer risk and hazard quotient (HQ) estimate (for non-cancer risk) will be calculated. The carcinogenic and non-carcinogenic results and risk summaries by pathway and receptor for current and future receptors exposed to site media will be presented in the HHRA.

References

Illinois Environmental Protection Agency (IEPA), 2007. Tiered Approach to Corrective Action Objectives, Appendix A, Tables G and H.

Indiana Department of Environmental Management (IDEM), 2014. Water Quality Standards Applicable to All State Waters Within the Great Lakes System.

National Library of Medicine (NLM), 2014. TOXNET, Toxicology Data Network, Hazardous Substances Database for Methane.

Parsons, 2016. Remedial Investigation/Feasibility Study Work Plan for the Gary Development Landfill Superfund Site, Gary, Indiana. January 2016.

USEPA, 1989. Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A).

USEPA, 1992. Supplemental Guidance to RAGS; Calculating the Concentration Term.

USEPA, 1993. Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluations Manual.

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USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355, December 2002.

USEPA, 2003. Guidance for Developing Eco-SSLs, November 2003.

USEPA, 2005. Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Facilities, September, 2005.

USEPA, 2011. Exposure Factors Handbook, EPA/600/R-090/052F.

USEPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, February 2014.

USEPA, 2015. Region 4 Ecological Risk Assessment, Supplemental Guidance, Interim Draft,

Virginia Department of Environmental Quality, 2016, revised March 25, 2017. Trench model, available in the Virginia Unified Risk Assessment Model (VURAM), http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/RemediationProgram/RiskAssessment.aspx

Attachment 1
RI Sample Locations

PARSONS

10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Air Sample Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal 1/9/2017

Revision: 1/9/2017

Figure No.: 1-1

Parsons Project No.: 448411.04000

File Name: AirSamples.mxd

D:\GIS\GaryLandfill\AGO\2017\AirSamples.mxd

PARSONS

10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

GPS Gas Vent Sample Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	1/9/2017	
Revision: 1/9/2017	Figure No.: 1-2	Parsons Project No.: 448411.04000
File Name: GasVent_samples.mxd		

D:\GIS\GaryLandfill\AGO\2017\GasVent_samples.mxd

PARSONS

10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Geoprobe Sample Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	1/9/2017	
Revision: 1/9/2017	Figure No.: 1-3	Parsons Project No.: 448411.04000
File Name: GeoprobeSamples.mxd		

D:\GIS\GaryLandfill\AGO\2017\GeoprobeSamples.mxd

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10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Monitoring Well Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	1/9/2017	
Revision: 1/9/2017	Figure No.: 1-4	Parsons Project No. 448411.04000
File Name: MW.mxd		

D:\GIS\GaryLandfill\RAGO\2017\MW.mxd

PARSONS

10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Staff Gauge Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	1/9/2017	
Revision: 1/9/2017	Figure No.: 1-5	Parsons Project No. 448411.04000
File Name: Staff Guage.mxd		

D:\GIS\GaryLandfill\RAGO\2017\Staff Guage.mxd

PARSONS

10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Sediment Sample Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	1/9/2017	
Revision: 1/9/2017	Figure No.: 1-6	Parsons Project No. 448411.04000
File Name: Sediment_samples.mxd		

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PARSONS

10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Surface Water Sample Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	1/9/2017	
Revision: 1/9/2017	Figure No.: 1-7	Parsons Project No. 448411.04000
File Name: SurfaceWater.mxd		

D:\GIS\GaryLandfill\RAGO\2017\SurfaceWater.mxd

PARSONS

10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Surface Water & Sediment Sample Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	5/1/2017	
Revision: 5/1/2017	Figure No.: 1-8	Parsons Project No. 449595.02000
File Name: BackGroundPond.mxd		

D:\GIS\GaryLandfill\AGO\2017\BackGroundPond.mxd

PARSONS

10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Surface Soil Sample Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	1/9/2017	
Revision: 1/9/2017	Figure No.: 1-9	Parsons Project No.: 448411.04000
File Name: surface_samples.mxd		

D:\GIS\GaryLandfill\AGO\2017\surface_samples.mxd

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Geotechnical Sample Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	1/9/2017	
Revision: 1/9/2017	Figure No.: 1-10	Parsons Project No.: 448411.04000
File Name: Geotech_samples.mxd		

D:\GIS\GaryLandfill\AGO\2017\Geotech_samples.mxd

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10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Soil Boring Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	2/22/2017	
Revision: 2/22/2017	Figure No.: 1-11	Parsons Project No.: 448411.04000
File Name: SoilBoringLocations.mxd		

D:\GIS\GaryLandfill\AGO\2017\SoilBoringLocations.mxd

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10 South Riverside Plaza, Suite 400
Chicago, Illinois 60606-3724

Test Pit Location Map
Gary Development Landfill Superfund Site
Gary, Indiana

C. Oneal	2/22/2017	
Revision: 2/22/2017	Figure No.: 1-12	Parsons Project No. 448411.04000
File Name: TestPitLocations.mxd		

D:\GIS\GaryLandfill\AGO\2017\TestPitLocations.mxd

Attachment 2
Updated Conceptual Site Model

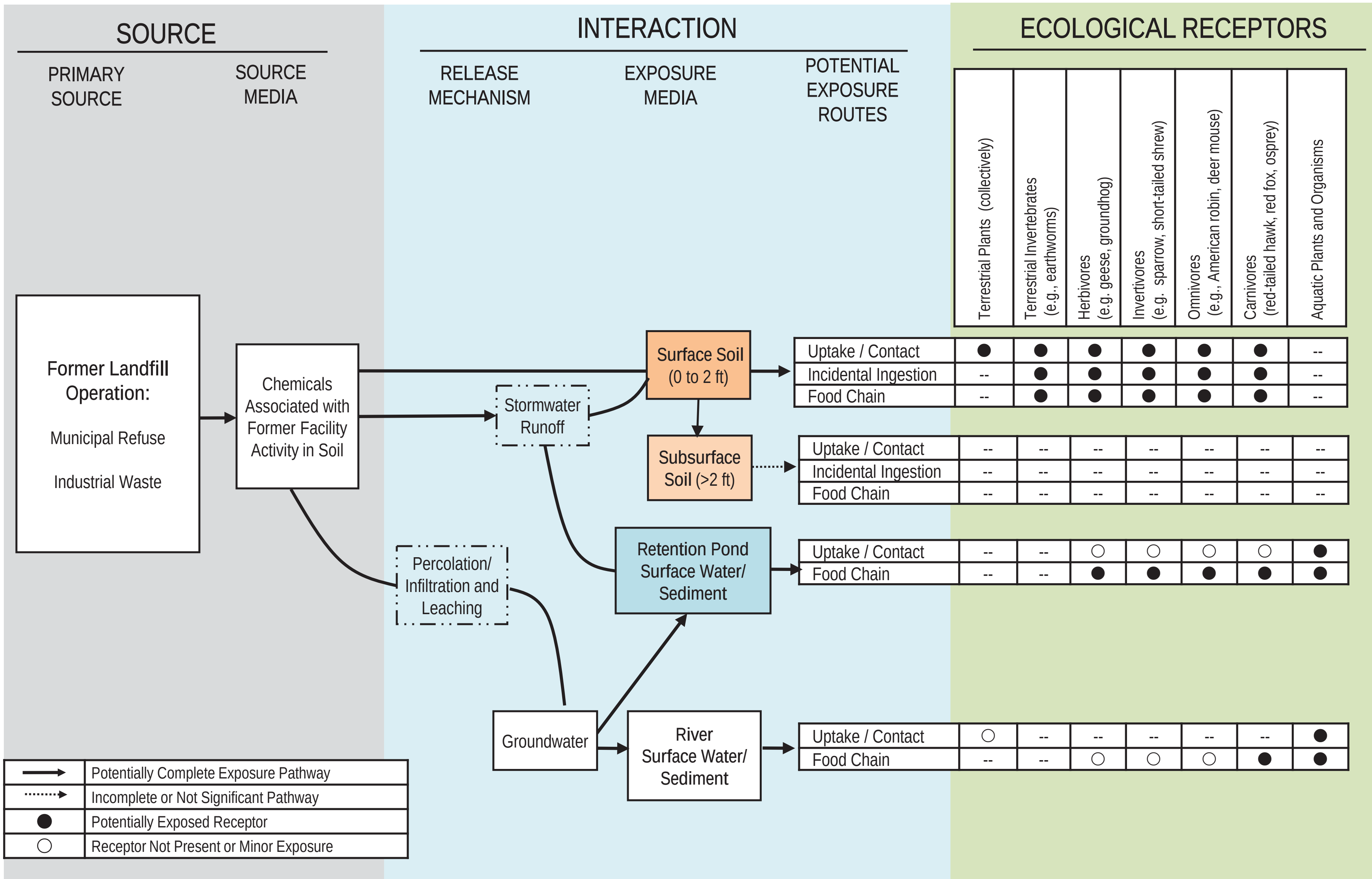
Figure 2-1

Ecological Conceptual Site Model – Current Conditions

Site Name: **Gary Development Landfill**

Completed By: **PARSONS**

Date Completed: May 2017



Exposure Media	Potential Exposure Routes	Terrestrial Plants (collectively)	Terrestrial Invertebrates (e.g., earthworms)	Herbivores (e.g. geese, groundhog)	Invertivores (e.g. sparrow, short-tailed shrew)	Omnivores (e.g., American robin, deer mouse)	Carnivores (red-tailed hawk, red fox, osprey)	Aquatic Plants and Organisms
Surface Soil (0 to 2 ft)	Uptake / Contact	●	●	●	●	●	●	--
	Incidental Ingestion	--	●	●	●	●	●	--
	Food Chain	--	●	●	●	●	●	--
Subsurface Soil (>2 ft)	Uptake / Contact	--	--	--	--	--	--	--
	Incidental Ingestion	--	--	--	--	--	--	--
	Food Chain	--	--	--	--	--	--	--
Retention Pond Surface Water/ Sediment	Uptake / Contact	--	--	○	○	○	○	●
	Food Chain	--	--	●	●	●	●	●
River Surface Water/ Sediment	Uptake / Contact	○	--	--	--	--	--	●
	Food Chain	--	--	○	○	○	●	●

Figure 2-2

Ecological Conceptual Site Model – Future Conditions. Presumptive Remedy: Landfill Cap Placement

Site Name: **Gary Development Landfill**

Completed By: **PARSONS** ***Date Completed:*** May 2017

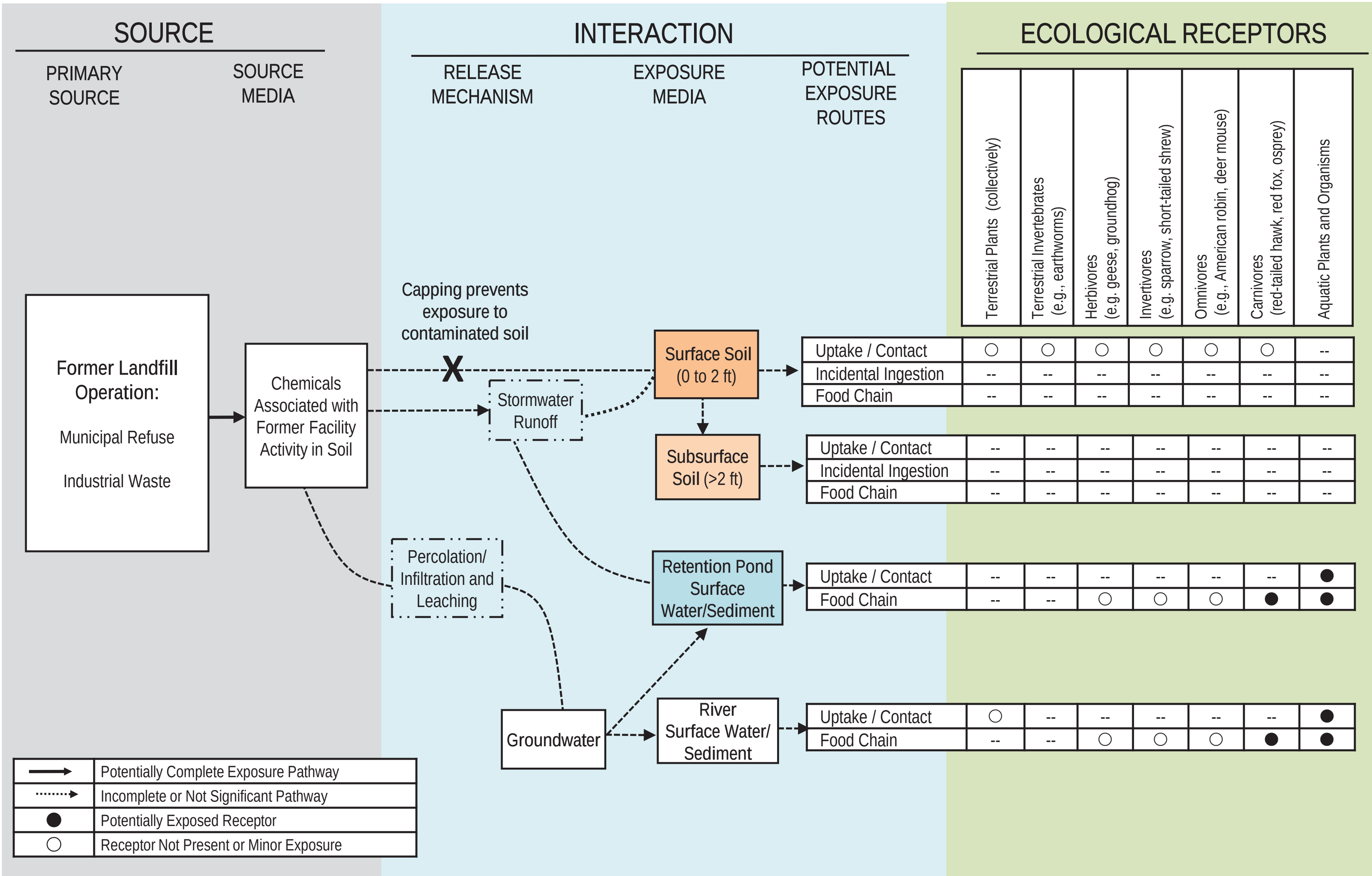


Figure 2-3

Human Health Conceptual Site Model – Current Conditions

Site Name: **Gary Development Landfill – Current Conditions**

Completed By: **PARSONS** ***Date Completed:*** May 2017

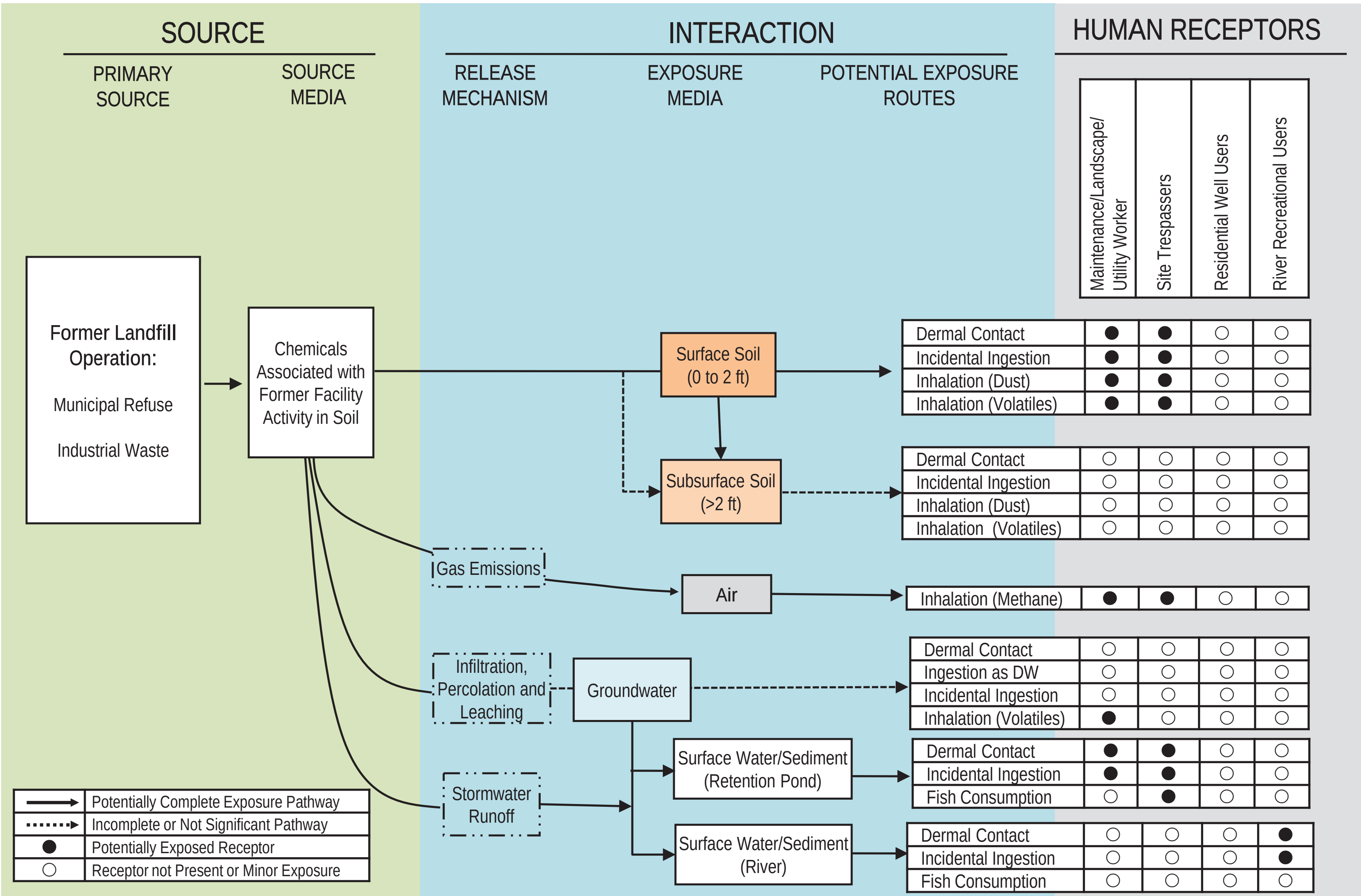
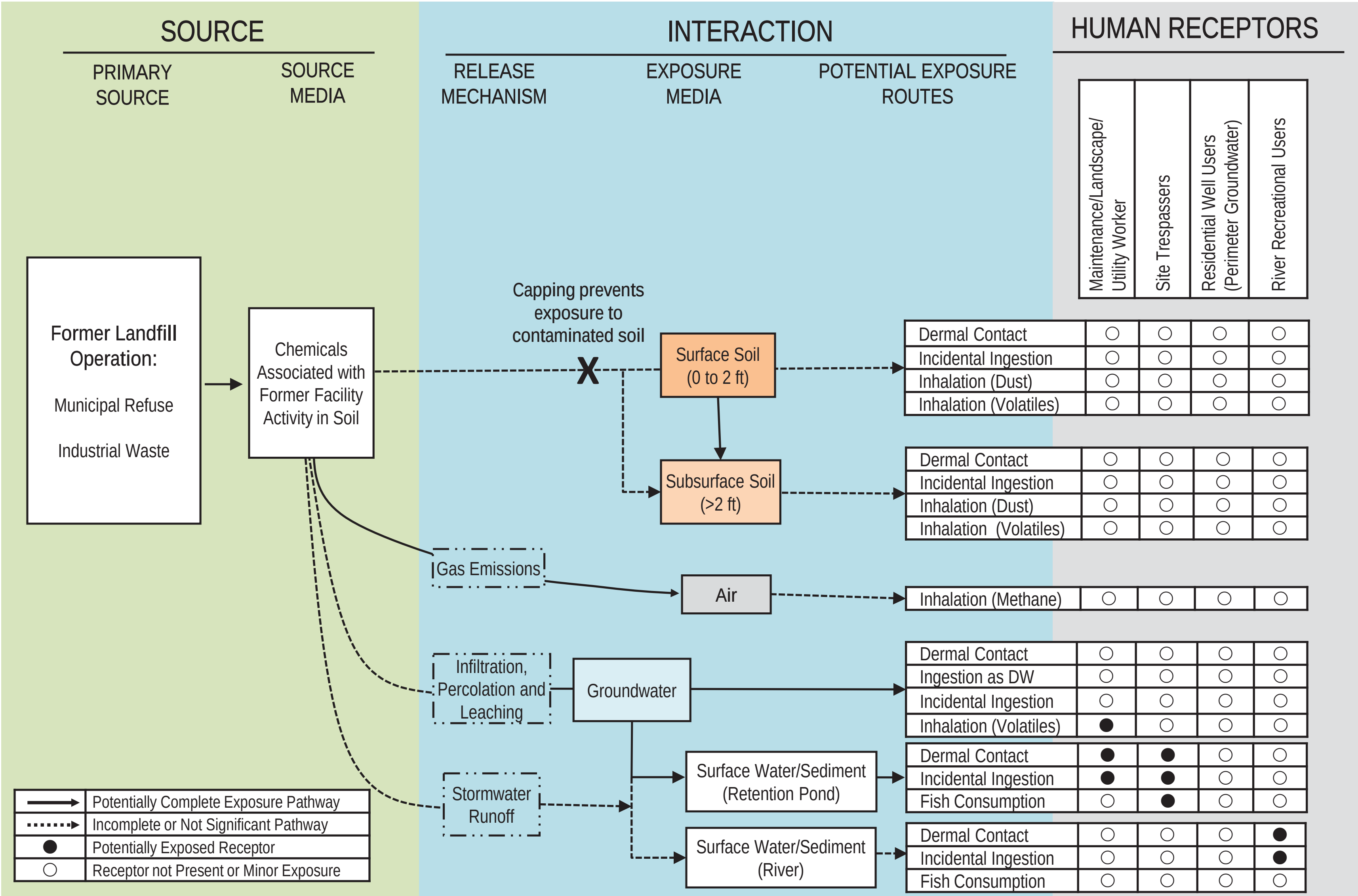


Figure 2-4

Human Health Conceptual Site Model – Future Conditions. Presumptive Remedy: Landfill Cap Placement

Site Name: Gary Development Landfill

Completed By: PARSONS *Date Completed:* May 2017



Attachment 3
Draft Exposure Parameters

Table 3-1
Summary of Dietary Exposure Parameters for Selected Ecological Receptors

Receptor Species	Body Weight (kg)	Typical Diet Composition	Food Ingestion Rate (FIR) (kg/kg-day)	Soil Intake (% of diet)	Foraging Territory (acres)
Bird Species					
American Robin	0.077	60 % plants 40% invertebrates	0.24	10.4%	0.37 - 2.0
Song Sparrow	0.02	25% plants 75% invertebrates	0.2	6.1%	0.5 - 1.54
Canada Goose	3.55	100% plants	0.04	8.2%	2200
Red-tailed Hawk	1.1	100% small prey	0.08	2.55%	576
Osprey	1.9	100% fish	0.21	0	2243
Mammal Species					
Deer Mouse	0.02	50% plants 50% invertebrates	0.17	2%	0.13 - 0.18
Short-tailed Shrew	0.018	100% invertebrates	0.1	13%	0.25 - 0.89
Groundhog	2	100% plants	0.051	2%	7
Red Fox	4.5	90% small prey 10% plants	0.08	2.80%	240 - 1280

Table 3-2
Site Trespasser Exposure Parameters for Surface Water and Sediment Pathways Under the Presumptive Remedy

Exposure Route	Parameter		Units	Reasonable Maximum Exposure (RME)	Rationale	Reference
General Parameters	Csw	Concentration in Surface Water	ug/L	chemical specific		
	Csed	Concentration in Sediment	mg/kg	chemical specific		
	EF	Exposure Frequency	days/year	52	1 day per week	Professional Judgment
	ET	Exposure Time	hours/day	2	Estimated daily visit for trespasser	Professional Judgment
	ED	Exposure Duration	years	10	Assumes adolescent trespasser 11 - 20 years of age	USEPA 2011, Table 10-5
	BW	Body Weight	kg	80		USEPA 2011, Table 8-3 and USEPA, 2014
	CF1	Conversion Factor 1	L/mL	0.001		
	CF2	Conversion Factor 2	mg/kg	1000000		
	AT-C	Averaging Time - carcinogens	days	25550	70-year lifetime	
	AT-N	Averaging Time - noncarcinogens	days	2920	8-years ED in days	
Surface Water Ingestion	IW	Surface Water Ingestion Rate	mL/hour	71	Recommended value for water ingestion for adult. Used in the USEPA's RSL Calculator as a default ingestion rate of water by adolescents while swimming.	USEPA 2011 , Table 3.5
Sediment Ingestion Rate	IRS	Sediment Ingestion Rate	mg/day	100	Incidental soil ingestion rate for adult. Used in the USEPA's RSL Calculator as a default ingestion rate of sediment by adolescents.	USEPA 1991 (pages 6 and 15) as cited in USEPA 2014
Fish Ingestion Rate	IRF	Fish Ingestion Rate	g/day	7.3	Adolescent (11-20 years) recreational freshwater angler (Michigan)	USEPA 2011, Table 10-5
Surface Water Dermal Contact	PC	Permeability Constant	cm/hour	chemical specific		
	SA	Skin Surface Area	cm^2	19652	Weighted average of mean values for male and female adults, ages 21-78; whole body. Used in the USEPA's RSL Calculator as a default skin surface area for exposure of adolescent recreational users to surface water.	USEPA 2011, Table 7.9 as cited in USEPA 2014
Sediment Dermal Contact	FC	Fraction Contacted	unitless	1	Entire exposure time spent at one exposure area	
	AF	Dermal Adherence Factor	mg/cm^2	0.07	Adult soil-to-skin adherence factor. Used in the USEPA's RSL Calculator as a default adherence factor for adolescents exposed to sediment.	USEPA 2004 (Exhibit 3-5) as cited in USEPA 2014
	AB	Dermal Absorption Fraction	unitless	chemical specific		
	SA	Skin Surface Area	cm^2	6032	Weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+ years)(forearm and lower leg-specific data used for males and female lower leg; ratio of male forearm to arm applied to female arm data). Used in the USEPA's RSL Calculator as a default skin surface area for exposure of adolescent recreational users to sediment.	USEPA 2011, Tables 7.2 and 7.12, as cited in USEPA 2014

USEPA, 1991. Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual Supplemental Guidance. Standard Default Exposure Factors. March 1991.
USEPA, 2011. Exposure Factors Handbook, EPA/600/R-090/052F.
USEPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, February 2014.

Table 3-3

Recreational User Exposure Parameters for Surface Water and Sediment Pathways Under the Presumptive Remedy

Exposure Route	Parameter		Units	Reasonable Maximum Exposure (RME)	Rationale	Reference
General Parameters	Csw	Concentration in Surface Water	ug/L	chemical specific		
	Csed	Concentration in Sediment	mg/kg	chemical specific		
	EF	Exposure Frequency	days/year	35	Estimated number of days based on 2 days/week from May 1 through September 1	Professional judgment
	ET	Exposure Time	hours/day	2	Estimated daily visit for recreational users	Professional judgment
	ED	Exposure Duration	years	6 20	Child Adolescent/Adult	USEPA, 1991 (p. 15) as cited in USEPA 2014
	BW	Body Weight	kg	15 80	Child Adolescent/Adult	USEPA 2011, Table 8-3 as cited in USEPA 2014
	CF1	Conversion Factor 1	L/mL	0.001		
	CF2	Conversion Factor 2	mg/kg	1000000		
	AT-C	Averaging Time - carcinogens	days	25550	70-year lifetime	
	AT-N	Averaging Time - noncarcinogens	days	2190 7300	6 years for a child 20 years or an adolescent/adult	
Surface Water Ingestion	IW	Surface Water Ingestion Rate	mL/hour	120 71	Child Adolescent/Adult	USEPA 2011 , Table 3.5 as cited in USEPA 2014
Sediment Ingestion Rate	IRS	Sediment Ingestion Rate	mg/day	200 100	Child Adolescent/Adult	USEPA 1991 (pages 6 and 15) as cited in USEPA 2014
Surface Water Dermal Contact	PC	Permeability Constant	cm/hour	chemical specific		
	SA	Skin Surface Area	cm^2	6365 19652	Child; weighted average of mean values for male and female children <6 years; whole body Adolescent/Adult; weighted average of mean values for male and female adults, 21-78; whole body	USEPA 2011, Table 7.9, as cited in USEPA 2014
Sediment Dermal Contact	FC	Fraction Contacted	unitless	1	Entire exposure time spent at one exposure area	
	AF	Dermal Adherence Factor	mg/cm^2	0.2 0.07	Child Adolescent/Adult	USEPA 2004, Exhibit 3-5, as cited in USEPA 2014.
	AB	Dermal Absorption Fraction	unitless	chemical specific		
	SA	Skin Surface Area	cm^2	2373 6032	Child; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years)(forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere) Adolescent/Adult; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+ years)(forearm and lower leg-specific data used for males and female lower leg; ratio of male forearm to arm applied to female arm data)	USEPA 2011, Tables 7.2, 7.8, and 7.12, as cited in USEPA 2014

USEPA, 1991. Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual Supplemental Guidance. Standard Default Exposure Factors. March 1991.

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355. December 2002.

USEPA, 2011. Exposure Factors Handbook, EPA/600/R-090/052F.

USEPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, February 2014.